MLQA
Models and Logics for Quantitative Analysis

Kick Off Meeting at ETAPS 2009

Flemming Nielson

http://www.MT-LAB.dk/MLQA

Why this meeting?

- The purpose of the Kick-Off meeting is to finalise the description of an application for MLQA to become a working group of ERCIM.

- Once established it will be open also to non-ERCIM members.

- The programme of the Kick-Off meeting:
  - Talks delineating the main components of MLQA.
  - Short presentations by participants.
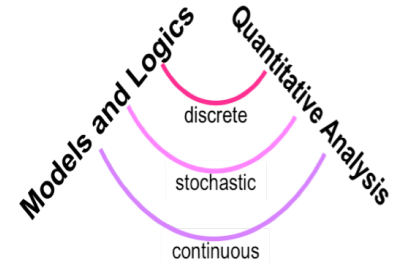 - Finalising the mission statement.

Why a working group?
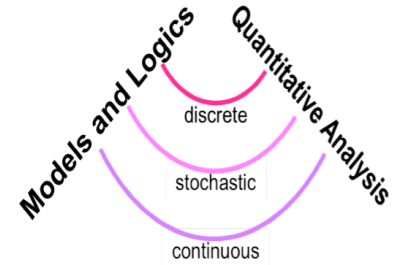
To cater for:

- knowledge sharing,

- networks also for young researchers,

- sharing tools developed within the field,

- discussing research directions, and

- eventually to formulate European projects or networks on formal quantitative analysis.

What is MLQA?

- **Process models** are described by transition systems, automata or process calculi.

- **Properties** are expressed in logics possibly involving stochastic and continuous (control theory) properties on top of discrete ones.

- **The focus** is on algorithms, theory and tools.

- **Applications** will include embedded systems, service oriented systems, biological systems, and IT guided workflow systems.
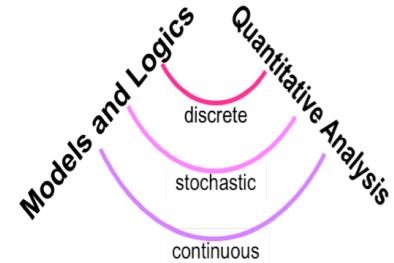
MLQA: Models of IT Systems
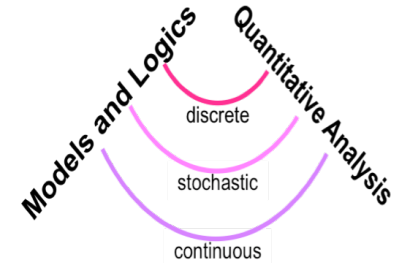
- The construction of IT Systems spans several abstraction levels:
  - low-level, hardware-oriented programming languages (e.g. VHDL),
  - high-level programming languages (e.g. C++ and Java) to
  - object-oriented development notations (e.g. UML).

- To ensure
  - applicability at all levels and
  - independence of concrete programming languages,

  we will model behaviour as *process models* expressed using
  - process calculi, transition systems or automata.

- The study of open systems is well studied but needs to be extended to the study of IT guided systems where the human components cannot be fully described.

MLQA: Specification of Properties
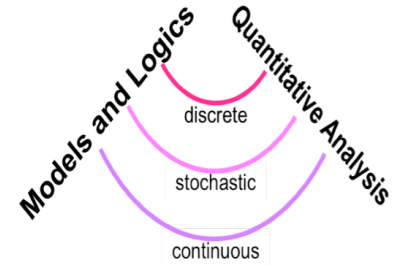
- International standards like
  - the *Safety Instrumented Systems* standard within embedded systems, and
  - the *Common Criteria* standard used for software in many NATO countries

  emphasize the need for validating that systems are
  - **functionally correct** (react as expected),
  - **dependable** (do not cause damage on environment or users),
  - **highly efficient** while demanding **few resources**,
  - **secure** (against hackers and viruses),
  - **stable** (do not crash),
  - **fault tolerant** (offers vital functionality even when partially crashed).

- To ensure a uniform approach we will be based on *logical specification formalisms.*

- They accommodate seemingly dissimilar properties within the same formalism and facilitate automatic validation engines.

MLQA: Discrete Properties

- *Static analysis* and *model checking* are two of the most prominent techniques for discrete systems analysis. In many ways they are complementary and largely developed by independent research communities.

- The techniques are used by some of the largest international companies (e.g. IBM, Intel, Microsoft).

MLQA: Stochastic Properties
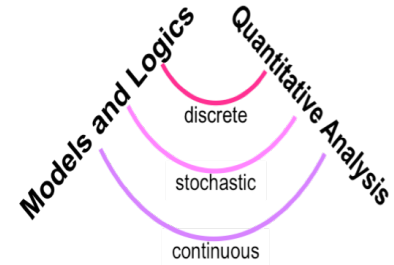
- The quantitative properties of the environment of a given IT System are often accompanied by uncertainties best described using stochastic or probabilistic models, such as *Markov Chains, Markov Decision Processes, and Continuous Time Markov Decision Processes*.

- From the point of view of *"traditional" mathematical modelling* the working group offers a unique chance to integrate and further develop recent advances in stochastic models.
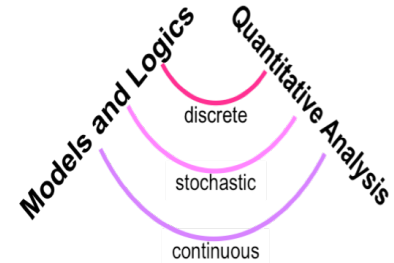
MLQA: Continuous Properties
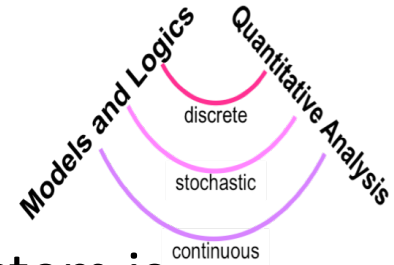
- In classical Control Theory the model of an IT System is through a set of *differential equations* describing the evolution of physical phenomena in the environment when regulated by a given control program.

- The area of Hybrid Systems has emerged in the intersection between Computer Science and Control Theory in order to deal with controllers that are not completely deterministic.

- From the point of view of *"traditional" mathematical modelling* the approach offers a unique chance to develop tractable ways of dealing with important control system properties, such as reachability and stability, which is currently beyond state-of-the-art.
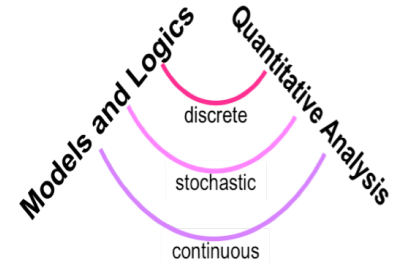
What is ERCIM?

- **ERCIM** is the **European Research Consortium for Informatics and Mathematics**
  - consisting of 19 European research institutions, and
  - sponsoring ETAPS.
- **ERCIM** aims to foster collaborative work within the European research community and to increase co-operation with European industry.

  This will provide an international forum for the exchange of ideas (and personnel).

  It may lead to the formulation of EU projects in future calls.

- Please consult *www.ercim.org* for more information.

Expectations of ERCIM
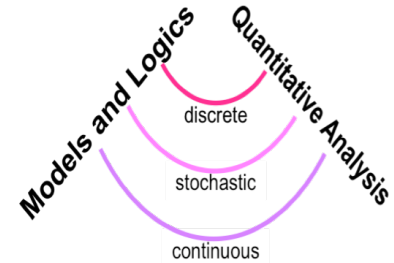
- An annual meeting (for 2009 this Kick-Off meeting, for 2010 a meeting at ...).

- Formulating a research programme – that can
  - influence activities at participating institutions and
  - lead to the formulation of an European project or network.

- Exploiting current funding possibilities to support the mobility of young researchers:
  - ERCIM fellowships, Marie Curie stipends, etc.

- A web page with information about activities, tools, and opportunities.

Why a NEW working group?

- The working group distinguishes itself from existing ERCIM working groups on
  - Formal Methods for Industrial Critical Systems and
  - Dependable Software-intensive Embedded Systems
- The more narrow focus on models and logics will be effective in fostering new synergies between existing research groups.
- The wider focus on application areas beyond those of traditional IT systems falls well outside existing ERCIM working groups on formal methods.
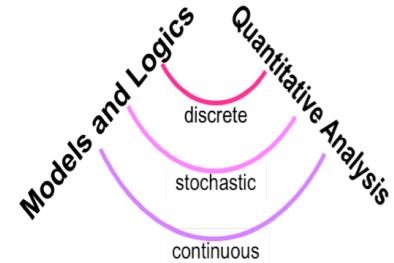
The programme …
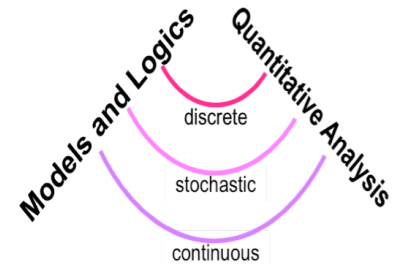
- Opening
  - Flemming Nielson: "An overview of MLQA"
- Invited Talks
  - Stephen Gilmore - stochastic analysis in PEPA
  - Carolyn Talcott - statistical model checking in Maude
  - Rocco De Nicola - process algebras for stochastic features
  - Diego Latella - applications to service oriented systems: "A Stochastic Logic for Mobility and Global Computing"
  - Holger Hermanns - applications to embedded systems
  - Paola Quaglia - applications to biological systems
- Presentations by participants
- Finalisation of mission statement

The programme …
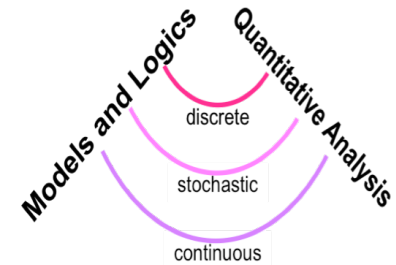
- Presentations by participants
  - Tino Teige (University of Oldenburg)
  - Herbert Wiklicky (Imperial College)
  - Vashti Galpin (University of Edinburgh)
  - Manuela Bujorianu (Cicada)
  - Stefan Kiefer (TU Munich)
  - Erik de Vink (CWI and TU/e)
  - Milad Niqui (CWI)
  - Ezio Bartocci (Universita Camerino)
  - Henrikas Pranevicius (Kaunas University of Techno-logy)
  - Sven Schneider (TU Berlin)
  - Mark Timmer (University of Twente)
  - Uli Fahrenberg (University of Aalborg)
- Finalisation of mission statement

The next steps …

- Make an application to ERCIM
  - The final mission statement
  - A summary of the present meeting
  - The list of attendees of the present meeting
  - Making sure the national ERCIM board members are informed and supportive
- Deadline April / May

The next steps …
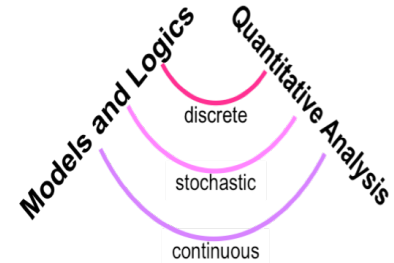
- Suggested procedure for finalising the mission statement
  - Comments and discussions on mission statement now
  - A small committee prepares the final version
    - Flemming Nielson, …
  - Request for comments by attendees (and others) by a specific date
  - Contacting national ERCIM board members
  - Submission of proposal